instances deceptive, and it will even be safer to trust to one's general ideas of sufficiency than to such rules. Palladio, for instance, has said that the openings of windows should not exceed a fourth, nor be less than a fifth, of the length of a side of a room, and should be in height two and one-sixth times the width. Mr. Gwilt has given the nearest approach to a definite rule that I have met with, which is to allow 1 foot of glass to 100 cubic feet of room. The subject, evidently, requires a more exact system of computation; and I trust, that whatever may be your opinion of the system now proposed, you will, at least, pardon the attempt. Some matters which come into a full consideration of the subject (it will be seen) are not ascertained with that precision which will result, I think, from experiment, conducted, except in one instance, on the basis of the system now to be defined. They do not, however, prevent a practical use being at once made of the system. One of these is of importance and requires careful investigation—viz. the proportion of light which is absorbed in its passage through different kinds of glass at different angles of incidence. Crown, sheet, and polished plate-glass, allow almost all the light to pass. Rough plate and ground glass, including rough plate ground either on the rough side, or that which is fire-glazed, are as transparent in their substance as the others, and the only additional absorption of light which takes place is owing to irregularity in the refraction of rays at the surfaces, many of them being so refracted into the substance of the glass as to be partially or wholly absorbed. If, therefore, the respective action of the three surfaces, viz. rough, fire-glazed, and ground, on rays of light at different angles of incidence, were determined, a very approximate proportion might be found, showing the relative obstruction by all these different kinds of glass. Fluted and embossed glass of various kinds may be added to the list, though, if the flutings and embossments are flat, probably they do not intercept the light more than the glass first above mentioned.

In forming any estimate of the light to be derived in any place, variableness in the sources of light must not be taken into account, but provision must be made, especially in our climate, for sufficiency under ordinarily unfavourable circumstances. For this reason, a southern* aspect must be treated as a northern, and the zenith as the horizon; though in towns the former is often by far the purer source. The hemisphere of sky will, therefore, be considered as an equable source of light.

Methods of estimating the proportions of Light passing through one or more openings.

When a plane is exposed to a hemisphere of light, the incident light is equal in every part of it, and, therefore, every figure on that plane receives light in proportion to its area. We shall consider the case of rectangles, and from them (including squares) we shall obtain the proportion on the inscribed circles, ellipses, and other figures by direct proportion.

As we must examine the subject with reference to the obstructions to the incident light which ordinarily occur, we must therefore find a measure which will give us the quantity derived from every portion of that hemisphere. Now, *to* every point in a rectangle (so exposed to a hemisphere of light) a ray falls *from* every point in the hemisphere. Systematising these rays according to their parallel directions—they would form an infinite number of prisms of which the rectangle is the common base. The light, however, falling on the rectangle may be measured *proportionably* by estimating the proportion of rays falling on the vertical planes, passing through the middle of its length and width respectively.

The next class of obstructions to day-light consists of external objects. These are so various in their forms and characters, and often practically so difficult to measure, that no very precise rules can be laid down. In towns they are chiefly buildings which may be generally classed as either parallel or perpendicular to the wall of the window, or nearly so. If the buildings are opposite to a window, and nearly parallel to the wall of the window, the angular height of the buildings, taken from the middle of the window, would give the proportion of obstructed light, and then the sums of the sines must be taken only to the angle made with the perpendicular by the line from the middle of the window to the top of the opposite buildings. This will give the direct light. The reflected light from the buildings would be found by applying the formula to the remaining angular height of the buildings, multiplied into such a fraction as would represent the ratio of the reflected light to that of the sky.

But in all cases of objects which are distant, it will be easy to form a judgment of the upper line of that which may be considered as the intercepted *lune* of light, two-thirds of the side obstructions, measured spherically, being allowed to one-third of the opposite ones in forming the average. In practice, I think this method will be found very easy of application. When the buildings are near, and come within the scope of the architect's measurements, then the light will be accurately ascertained by reckoning the lines which form the outline of the unobscured portion of sky as the *outside* of the opening which admits light.* Where there is a roof, as of a portico or verandah over the window, the outside lines of the soffite must be considered to be the outside of the opening. Generally it may be remarked on this head, that accessible obstructions may be estimated by supposing them as parts of the sides of the openings—inaccessible ones being more distant, it is of less importance to estimate accurately.

Method of estimating effective light passing into a Room.

We have as yet considered the proportions of light passing through openings; it remains to inquire into the effect of the light in a room.† The distance to which light passes into a room after admission, though it makes no difference as to *quantity* (because exactly as the intensity of light diminishes, so the area of surface lighted increases, viz. as the square of the distances from the opening to the parts where it falls); yet, in practice, a room is found to be much better lighted when the light passes far into a room than when only to a short distance. This effect is caused, perhaps, first, by the eyes adapting themselves to particular lights by a slight alteration in their form, and thus, if a room be partially lighted, they adapt themselves to the stronger partial light, and the other parts appear more gloomy. The converse of this is shewn by the effect of sunlight produced at dioramas, &c. by the direct light from the sky contrasted with the darkness of the remainder of the room. The second cause is, perhaps, the better adaptation of the whole room to use when all is sufficiently lighted, than when part is lighter than necessary, and part too dark for comfort. There are probably no means of forming an exact estimate of the value of the distance traversed by light after admission before it falls on the surfaces of the room. The value certainly varies where the distance varies, but it also does not vary so rapidly as the distance. From this (and consideration of facts), I think the effect (though not the quantity) of light may be deemed to vary as the square root of the average distance through which it traverses a room. For ascertaining, then, the *effective* light, the numerical value of the proportionate *quantity* should be multiplied by the square root of the distance.

Little has been yet said with regard to the light reflected from external objects. These vary exceedingly, not only in the light or dark colours of the surfaces, but also in the quantity of light falling on the surfaces, both which circumstances greatly affect the quantity of light reflected from them. Where opposite buildings are very near to one another, they will be shadowed by one another; and, therefore, much less reflected light will result in such cases. Much may doubtless be done by having white or light-coloured surfaces, but perhaps no surface obtainable for a wall exposed to the open air can permanently reflect more than one-tenth of the light received upon it.

Method of ascertaining definite effects of Light.

A surer mode of lighting rooms in such places will be proposed below, and I will now pass to my second object, of endeavouring to settle the *numerical proportions* obtained by the above-mentioned processes into *definite effects*. Now the only means of coming to a result on this head is to show the numerical proportions which, on the basis of the forms of estimate before given, are found in different existing buildings. From our knowledge of the effect which we can perceive in such buildings, we may determine the number which should be assigned to rooms of different kinds for, say every 100 cubic feet in the room. At a future time, I hope to collect more examples than I have as yet been able to do; and till then I shall not attempt to settle those numbers for fear of misleading, but will only give the results in a few buildings where the estimates have been made, viz. :—

Pantheon at Rome.

Cubic contents (without side chapels)	1,889,873ft.
Numerical value of light	9,003,507
Numerical value per 100 cubic feet..	476

Rotunda, Bank of England.

Cubic contents	126,477ft.
Numerical value of light	1,933,023
Numerical value per 100 cubic feet..	1,500

New Drawing Office, Bank of England.

Cubic contents	201,210ft.
Numerical value	5,879,250
Numerical value per 100 cubic feet..	2,922

Freemason's Hall, Great Queen-street.

Cubic contents	98,192ft.
Numerical value	2,136,922
Numerical value per 100 cubic feet..	2,170

Great Hall, Euston Terminus.

Cubic contents	483,730ft.
Numerical value	5,275,452
Numerical value per 100 cubic feet..	1,090

Means of obtaining additional light where definite effect is too little, and of estimating the additional effect.

This object, the third proposed, may be obtained by the use of reflectors. Very little use has hitherto been made of this expedient, and this is probably owing to the difficulty (often the impossibility) of placing a reflector so that it will be, at the same time, in a proper position for reflecting the light to particular parts, and yet neither obstructive nor unsightly; and to the difficulty of regulating any such reflector, and of obtaining reflectors which will not be injured by the sun, the weather, and the atmosphere of towns.

A single reflector may generally be placed on either the outside or inside of a window or skylight, so as to throw the light from the (perhaps small) portion of sky which remains unobscured over head, to any part in which more light is required. But besides the objections already mentioned to a single reflector, there is also a considerable loss of side light, either by the reflector, if within the window, being partly obscured by the window-jambs, or if without, by its reflecting part of the side light against the outside of the wall, and not into the room. All these difficulties may be overcome, in almost every case, by, as it were, cutting up the single reflector into strips, and arranging them one above the other, either in the reveal of the window, or in some other part where it will not interfere with ventilation or the action of the sashes. These combinations may be arranged horizontally, vertically, or obliquely, according to the positions of the centre of the unobscured portion of sky, and of the part into which the light is to be thrown, and according to the shape of the opening in which the combination is to be placed.

ROBERT HESKETH.

* A southerly aspect should be considered as desirable, not so much in respect of light as of warmth, and of the enjoyment we, in our dull latitudes, derive from an occasional gleam of brightness. The regulation of such light is more fitly effected by blinds and curtains than by structural provisions.

* This was illustrated by reference to a diagram.

† The difference occasioned by the manner in which a room is to be coloured or furnished cannot form the subject of any rule, but must be taken into account by estimating the effect of light in existing examples of various classes of rooms.